Radio Frequency Interference Mitigation to Improve Pulsar Timing using Spectral Kurtosis

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The Pulsar Timing RFI Mitigation Pilot Project is part of the Software Enabled Radio Astronomy (SERA) group. SERA is a collaboration dedicated to test and implement new methods of mitigating RFI for all types of radio astronomy. Over the course of the summer, we designed a program, accounting for this hardware limitation, to test the effectiveness of a real-time Spectral Kurtosis estimator in the improvement of pulsar timing residuals.

We investigated the effectiveness of Spectral Kurtosis (SK) as a radio frequency interference (RFI) mitigation technique for single-dish radio telescopes, using .raw files from the GUPPI (Green Bank Ultimate Pulsar Processing Instrument) backend system. The data set being used contains observations of pulsar J1713+0747 taken in June 2014 during a 24 hour observation period, in which telescopes across the world took data on J1713+0747 to improve the timing of the millisecond pulsar.

The main goal of the whole project is to perform the Spectral Kurtosis algorithm on observations made in real-time to improve pulsar timing residuals. The goal for the course of the summer were to conduct initial tests for the program. These initial tests were offline and designed to determine the effectiveness of Spectral Kurtosis as a mitigation technique in improving pulsar timing residuals. The program designed for initial testing was completed in Python, while the final product, which will be compiled after we test the effectiveness of the technique, will be written in C++ and wrapped in CUDA before installation on the GUPPI backend system on the Green Bank Telescope.

The focus of the presentation will be the design of the program and the method of testing the effectiveness of the program in flagging RFI while avoiding false positives.